# Keone'o'io & Ahihi Kina'u Natural Area Reserve
# Makai Watch Naturalist Reference Manual

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DRAFT 2007


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# Makai Watch

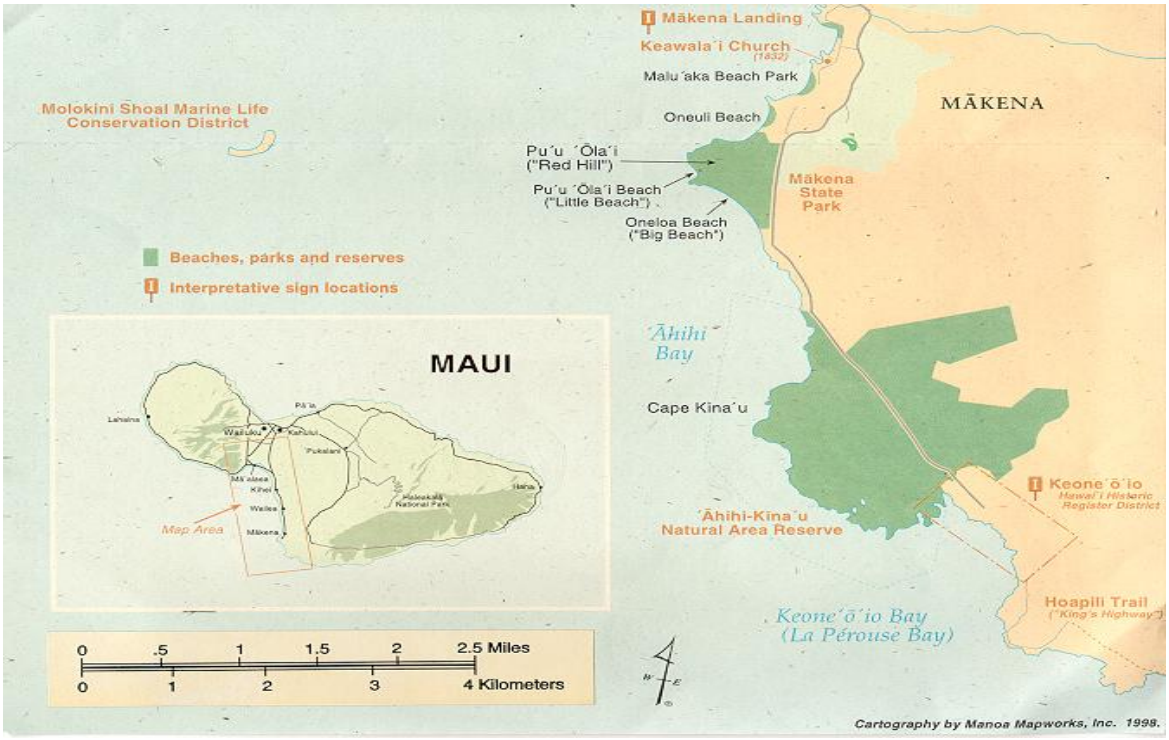

**Top View of `Ahihi Kina`u Natural Area Reserve (Photo – www.onecreations.net)**

*Aloha*! Congratulations and mahalo to those who have chosen to provide your time and energy to Hawai'i as a naturalist and/or volunteer in the statewide Makai Watch program.

The Makai Watch Program is a partnership effort between the Department of Land and Natural Resources (DLNR) and several non-governmental organizations including The Community Conservation Network (CCN), The Nature Conservancy (TNC), The Hawaii Wildlife Fund (HWF), Project SEALink, and several community organizations. The goal of Makai Watch is to enhance the management of near-shore marine resources by providing community members an opportunity to become directly involved in this management.

Makai Watch is a means for concerned citizens to play a role in ensuring proper management of marine resources. The program is currently focused on specific communities rather than citizens at large. Makai Watch is focused on reducing inappropriate use of marine resources by raising awareness, encouraging compliance, and in cases of severe or persistent violations helping to collect information that the Division of Conservation and Resource Enforcement (DOCARE) can use to identify and site violators. Through this combination of encouraging compliance and providing information to enforcement officers, Makai Watch will reduce inappropriate uses of marine resources thus helping Hawaii's near-shore marine ecosystem to recover.

Makai Watch Projects are established by specific communities with technical assistance from DLNR and one of the participating NGOs. Community members are responsible for organizing themselves, recruiting participants for the project, attending training, and then implementing Makai Watch elements. While technical assistance on all aspects of Makai Watch may be available, the community must be the primary mover behind its Makai Watch Project.
This program was developed by a consortium of communities and ngo's including Hawai'i Wildlife Fund and has been accepted by the Department of Land & Natural Resources as an official program. As the first information person positioned in a very popular natural area, you have quite a potential to influence those visitors who cross your path. (*See Getting Involved in Caring for Hawai'i's Coastal Resources: A Community Guidebook*, for more information).




**Map of Keone'o'io area (Cartography: Manoa Mapworks, Inc., 1998)**

# Introduction

The area chosen for the focus of this Makai Watch is the Ahihi Kina'u Natural Area Reserve (NAR) and nearshore environs directly adjacent to its southeast boundary: Keone'o'io. This manual focuses on Keone'o'io, as that has been the area of greatest human visitation during the last 10 years (with an average of 719 people/day). There is also a little bit of information included about Makena as it is an area on the northwest side of the NAR of great interest to the visitors and residents.

In 1997, when HWF first got involved in forming a community-based management group for the area between Makena and La Perouse Bay, there was virtually no resource agency presence on site, and the agency tasked with management under DLNR was under-supported. Within the next 5 years, due to Internet advertising and specialty guidebooks, etc., tourists and commercial kayak tours were thronging the Natural Area Reserve at Ahihi Kina'u, La Perouse Bay and Keone'o'io. During this time, several ad hoc and formal advisory groups (including Friends of Keoneio, the Keone'o'io – Kanaloa Working Group, and the Keone'o'io Advisory Group) formed to assist the state DLNR in managing the area to better protect it from being loved to death. In 2000, HWF produced a Naturalist Training Manual (Vann & Burger) and began formally training volunteers. In 2002, HWF began documenting human usage impacts to this area and educating the visitors at the Ma'aonakala (northwest) end of the NAR since fall, 2004. This area has become a model for the state now, progressing from virtually no on-site management of the area, including minimal signage, to pro-active and now adaptive management. These efforts were largely driven by community concern and supported by funding HWF efforts from Hawai'i Community Foundation, Hawai'i Tourism Authority, the Harold KL Castle Foundation, the National Fish and Wildlife Foundation and the Department of

Aquatic Resources of DLNR. Additional funding has also assisted the resource managers to hire rangers who have moved the program into active management.

The DLNR-DOCARE staff on Maui and throughout the state are supportive of this project. The presence of HWF Naturalists and Department of Forestry and Wildlife Rangers (DOFAW) has already begun to reduce human impact to the area through education and surveillance of illegal activities. The DOCARE works closely with the naturalists and rangers at the site to respond swiftly to suspect activities. In addition, the local community and volunteers are integrally involved and support this project. Recently, a precedent setting case was brought against a marine tour boat operator who illegally conducted a tour and anchored in the NAR waters. For damaging coral with his anchor, he was fined a record $7,300.00. This case received widespread publicity including cover stories in the Honolulu Advertiser and The Maui News. In addition, the Board of Land & Natural Resources gave the managers authority to impose visiting hours for the NAR. These two issues were coupled in the newspaper articles, which serve to lend a sense of urgency to protection of this NAR. The ensuing confusion and concern that rippled through the community and with visitors was addressed directly onsite by the Naturalist and Ranger teams. Without such personnel in this location, there would have been many people who went away bewildered and alarmed.

Having the Naturalists and volunteers stationed at education stations at one end of the NAR and roving at the other end, coupled with roving DOFAW rangers is a vast improvement to on-site management. This program is an exemplary model for the state of Hawai'i.

## Overall Goal

The overall goal of this effort is to promote *E Malama*, a Hawaiian expression meaning to, in all situations, have an attitude of interest and concern for today and the future. Our intent is to help preserve and protect this unique area by educating the general public about how to enjoy the resources of Keone'o'io with an attitude of appreciation and respect for the fragility of these resources. With this in mind, these are our primary objectives:

### Primary Objectives

1) Establish trained naturalists at Keone'o'io and the Ahihi Kina'u NAR.
2) Provide information and educational materials to visitors.
3) Promote dialogue with the public and foster a stewardship ethic.
4) Observe visitors' interactions with dolphins, other marine life, and archaeological sites, as well as record these observations.

### The Naturalist Training Program

The Naturalist Training Program has been developed to meet the objectives stated above. The vision statement for the Naturalist Training Program is:

> To grow in strength as a community-based program; to encourage a stewardship ethic among visitors and residents; to promote the well-being of the area's resting Spinner dolphins, other marine life, and archaeological sites; and to ignite interest and curiosity in the area.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

**Private land adjacent to Keone'o'io (Photo: Gaines Frazier)**

## How to Use this Reference Manual

This manual serves as a resource for naturalists who are stationed at Keone'o'io and the NAR to interact with the public. It contains more in-depth information about topics covered in naturalist training sessions. Naturalists are not solely book-trained, nor can one class give a person a Naturalist's training. Naturalists must spend lots of time in the environment/ecosystem of interest to better understand and interpret it.

In this document you will find information ranging from geology to marine ecology to ancient history. Each section is self-contained by subject. It is intended to spark your abilities as naturalists, and to serve as a catalyst for independent research into your own areas of interest. Each section contains references for additional reading for this purpose. Thank you for giving your time to help preserve this amazing place. Enjoy!

# Understanding Keone'o'io

Located several miles past Makena State Beach on Maui's southeast shore, Keone'o'io is remote and wild. It is a special place, rich in beauty and full of a spirit that still lives on in the land and life that is there. The name *Keone'o'io* may mean "Beach of the Bonefish", after the *o'io* (bonefish) still found there.

If you stand on the rocky shore at Keone'o'io and gaze out upon the Pacific waters to the south, you may see a pod of Hawaiian spinner dolphins swimming by, or sea turtles, or a little farther out, humpback whales casting misty breath or tail flukes into the air.

To the west are coral reefs, extending out into the bay, and schools of rainbow-colored fish which inhabit their waters. Looking north, you behold the volcano Haleakala, the "House of the Sun". You can see cinder cones on the grassland slopes above, and the dark black lava flow which cascades down for miles and eventually ends in the waters at Keone'o'io. These lava rock formations tell the story of the most recent volcanic eruption on the island.

To the east, among the dry lowland scrub vegetation are the many lava rock walls, platforms, and temple sites of the ancient Hawaiians who lived there until recent centuries. Some of the sites are intact, some are in states of ruin, and others are yet to be discovered.

Because of its special nature, Keone'o'io (also known as La Perouse Bay, after the French explorer Jean-Francois Galaup Compte de La Perouse who anchored in the bay in 1786), attracts many visitors to the site each day: people arrive for activities such as fishing, surfing, camping, kayaking, snorkeling, swimming with dolphins, and hiking.

Keone'o'io comprises approximately 14 acres of land, and is owned and managed by the State of Hawai'i's Department of Land and Natural Resources (DLNR) as "unencumbered lands". Under current regulations, camping and overnight stays are illegal except for purposes of fishing. Keone'o'io is bordered by privately owned land, mostly under the ownership of Ulupalakua Ranch.

While some people are using the area responsibly, others are not. In response to this situation, Friends of Keone'o'io and several other groups formed to help rally community resources to protect and preserve this special place for current and future generations. This grassroots community group was composed of stakeholders of the area and organized by Hawai'i Wildlife Fund in collaboration with the DLNR's Department of Forestry and Wildlife. Numerous community meetings were held to begin the discussion of how the community could help the DLNR in managing this largely unmanaged area and the adjacent Natural Area Reserve.

**Looking toward Keone'o'io (Photo: M. Evanson)**

## A Brief History of Makena

*Makena* means land of abundance, plenty, and was once a thriving community with over one hundred families living in the area until the mid-1920s. It was well known for fishing as the abundant akule fish came to the area to spawn. Reminders of the ancient ways can be found in the red earth, *heiau* (temples), ruins of old fish ponds, and a healing sanctuary beside a Christian chapel that has served the community since the 1930s, *Keawala`i* (calm bay) Church. The church was constructed primarily out of coral blocks cut from nearby reefs, is home to an active Protestant congregation, and is the prominent landmark in *Makena.*

*Makena* Landing was once one of the busiest ports on Maui, second only to the bustling Lahaina Harbor. From *Makena* Landing, cattle from upcountry swam to waiting boats, and potatoes and other produces were loaded on ships bound for California.

In the late 1950s there was a sugar plantation at Ulupalakua, which was sold to a retired sea captain, James Makee. By 1866, under his direction, the Makee Sugar Mill ranked third in tonnage among the ten mills then operating in Hawai`i. After Makee's death, a drought forced the closing of the mill and plantation. Makee's Rose Ranch, famous for its beauty and hospitality, became a cattle ranch and was renamed Ulupalakua Ranch. *Makena's* prominence as a landing increased substantially with the shipping of cattle from Ulupalakua Ranch on steamships.

During World War II, the U.S. Army occupied *Makena* as a training area and built barracks and bunkers and the shoreline road. They also tore down the historic pier at *Makena* Landing. After the war, few of the original residents returned to live in the area.

Today, most of the *Makena* area has remained undeveloped other than the *Makena* Resort developed by the Seibu Corporation.

**Big Beach shore break**

**Makena State Park**

A visitor may have gone too far in search of those white sandy beaches of Hawai`i and ends up at the NAR table. Below is some information you may find helpful in directing people back to Makena State Park. Depending on the mood and schedule of the visitor, encourage them to participate in *malama `äina* ( to respect and care for the land) practices wherever they are. If they are going to these beaches particularly to swim with turtles (the whole coastline has been marketed as "Turtle Town" in several visitor publications), be friendly and confident in your reminders to them that even though they will be leaving the reserve, the federal laws of endangered species protection still apply and they should keep a respectful and lawful distance.

Recent Park Hours Change – 5AM-6PM.

Description - This state park encompasses 165 coastal acres south of Wailea on Maui.

Attractions - *Makena* State Park includes a large, white-sand beach, and Pu'u Ola'i cinder cone. The cinder cone is the most prominent feature of this state park and lies north of the beach area. This popular beach is sometimes referred to as "Big Beach". The beach is over one-half mile long and more than 100 feet wide. A lifeguard is on duty but beware of a dangerous shorebreak. If you're facing *makai* (toward ocean), right over the cliffs to your right is what has become a popular but controversial nude beach, Little Beach.

The site has limited development with pit toilets being the only facilities. There is no drinking water available at the site.

Recreation - This state park is an excellent site for beach activities. Water-oriented recreation should be limited to days of calm seas, as at any beach location. Swimming, body surfing, board surfing and shore fishing are all popular activities from *Makena's* white sands.

Climate - The climate is pleasantly mild on Maui throughout the year. Temperatures vary annually between 60 and 90 degrees F. Summer temperatures range from 68 to 82 degrees F with the water usually

near 80 degrees. Winter temperatures vary from 61 to 80 degrees F with the water temperature close to 77 degrees. More rainfall occurs during the winter than other seasons of the year and most of it falls on the northeastern or windward portion of the island. Temperatures on this island vary more with elevation than seasons. Expect temperatures to drop four degrees F for every 1,000 feet gained in elevation.

Location - This state park is located on the western shore of east Maui, south of Wailea. To access the site travel to the end of Wailea Alanui Road.

**Little Beach Sunday at sunset**

## Teaching Themes and Safety

The Hawai`i Wildlife Fund is promoting the Think Island campaign. This theme embodies the concept that island ecosystems are easily disrupted and must be treated with care. The "Think Island" campaign is a program of Hawai'i Wildlife Fund begun at the suggestion of several Hawaiian kupuna (elders) and coined by several kupuna and the traditional Polynesian navigator, Nainoa Thompson. Fundamental guiding principles of this program include:

Think finite resources
Think sustainable living
Teach Hawaiian values of malama (to cherish) and aloha (love)
Think global/act local/promote sustainable living practices
- Teach Hawaiian values of malama (cherish) and aloha
- Learn from Hawaiian watermen/women and leaders in community
- Teach about endangered species as a focus of pride
- Teach Best Management Practices and water conservation practices

Working together with kupuna, we intend to educate the public about "Thinking Island." In a general sense, this teaches respectful and thoughtful methods of behavior around all sensitive natural and cultural sites. The intention is not to direct them to a particular sensitive site, but

rather to assist them in accessing the beauty and spirit of any place they visit in a safe, responsible manner.

Basic tips to teach Think Island theme and safety…

● Archeological sites

—Respect the culture

—Fragile construction

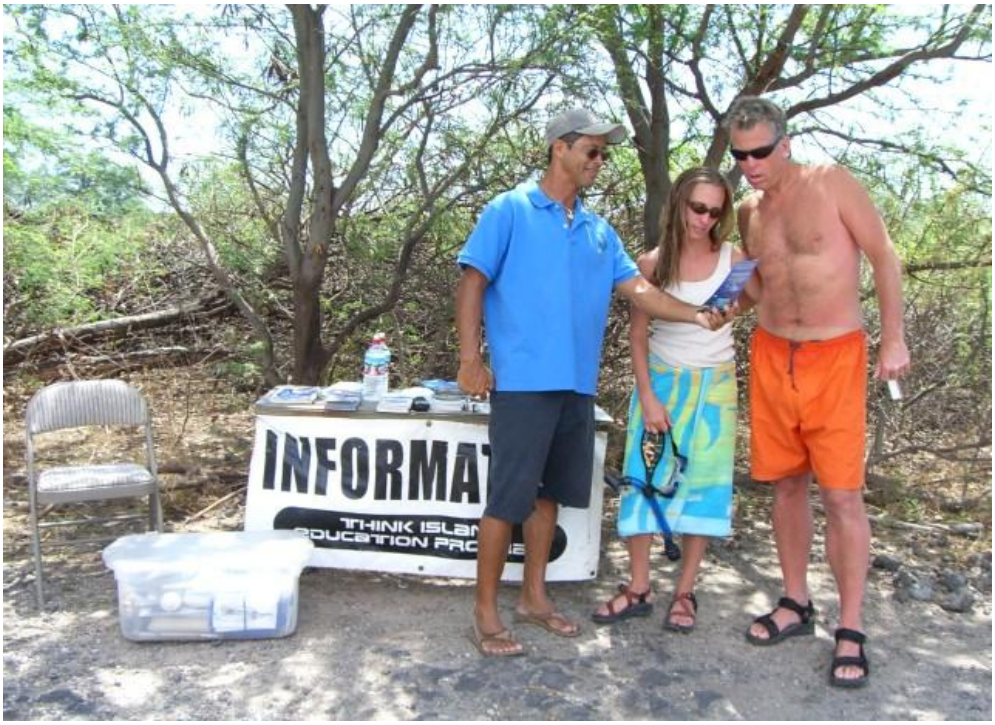
—Do not take anything

—Do not rearrange anything

—Stay on marked trails

—Use Porta Potties,

not lava fields




● Hiking Guidelines – From Na Ala Hele

Stay Together

—Avoid Undue Risks

—Stay on the Trail

—Monitor the Weather

—Watch the Time

● If Emergency occurs:
Call 911: Ask for Fire/Rescue

- Be Visible
- Be Noisy
- Stay Calm
- Stay Put

- Stay Warm

- Outside Activities Guidelines

  - Hike, Swim, Snorkel, Surf With a Partner

  - Inform Others of Your Plans

  - Get Information About the Trail, Site

  - Assess Your Capabilities

  - Check Weather Conditions
    - Maui, Moloka‘i, Lana‘i 877-5111
      Website www.nws.noaa.gov/pr/hnl

  - Wear Proper Clothing, Equipment

  - *Drinking water is a must*

  - Protect the Native Environment

  - Health Warning - *Leptospirosis*

- Ocean Awareness – Protect Yourself

  - If in doubt, don’t go out

  - Never turn your back on the waves

  - Watch the ocean conditions for ~15 minutes before entering

  - Check with locals/volunteers about conditions and safest points of entry

Don’t touch anything underwater

- Ocean Awareness – Malama Kai

  - Protect ocean wildlife – don’t toss trash, nets, line or plastic in the water or on the beach

  - Be considerate – don’t feed any sea creatures or disturb, chase or harass them

  - Protect the reef – keep your body and gear from touching the reef

—Take only pictures, leave only bubbles

—Learn the laws for fishing and protected species

## Be Akamai

The campaign also intends to teach visitors to be akamai (smart) about their own safety. This is a remote area and injuries can be serious and harder to manage. It is also our intent to provide a safe working environment and ensure that our teams understand measures that help us maintain safety.

- After calling 911, report all accidents, incidents or injuries to the Ranger on duty. After the emergency has been handled contact your supervisor (Hawai'i Wildlife Fund or Action Ahihi)
- Immediately report unsafe conditions and work practices to your immediate supervisor.
- Get help lifting awkward or heavy materials.
- Lift with leg muscles – crouch close to load, bend legs and keep back straight.
- Suggest ways to improve safety in Reserve to DOFAW supervisors.
- **Never put yourself in danger, especially if you witness a violation. Don't risk a confrontation.**

Another safety issue in this area is confrontations with aggressive people or DLNR rules violators. Techniques for approaching or discussions with the public:

How to handle irate people

1. Identify yourself and give a calm explanation of what you do.
2. Ask very kindly to be informed about what they're doing or what they're concerned about.
3. If a vehicle is parked inappropriately, kindly ask them to remove the vehicle.
4. If you get mistreated, remove yourself from the scene.
5. Capture as much information as you safely can and fill out Incident Report
   Vehicle description/license plate
   Individual description

Why is it difficult to deal with irate people?

- They're usually after a battle, not a solution.
- They can use verbal techniques that are inappropriate for you to use.
- They aren't likely to be in a solving mood.

How can you deal most effectively with irate people?

1. Thank the person for their comments.
2. Acknowledge that points brought up are important.
3. Acknowledge the need for more information concerning the issue.

4. Invite the critic to do something about the issue and provide him/her with a means of action (e.g., give hin/her the name address and phone number of a "higher authority" – Ranger Matt Ramsey).

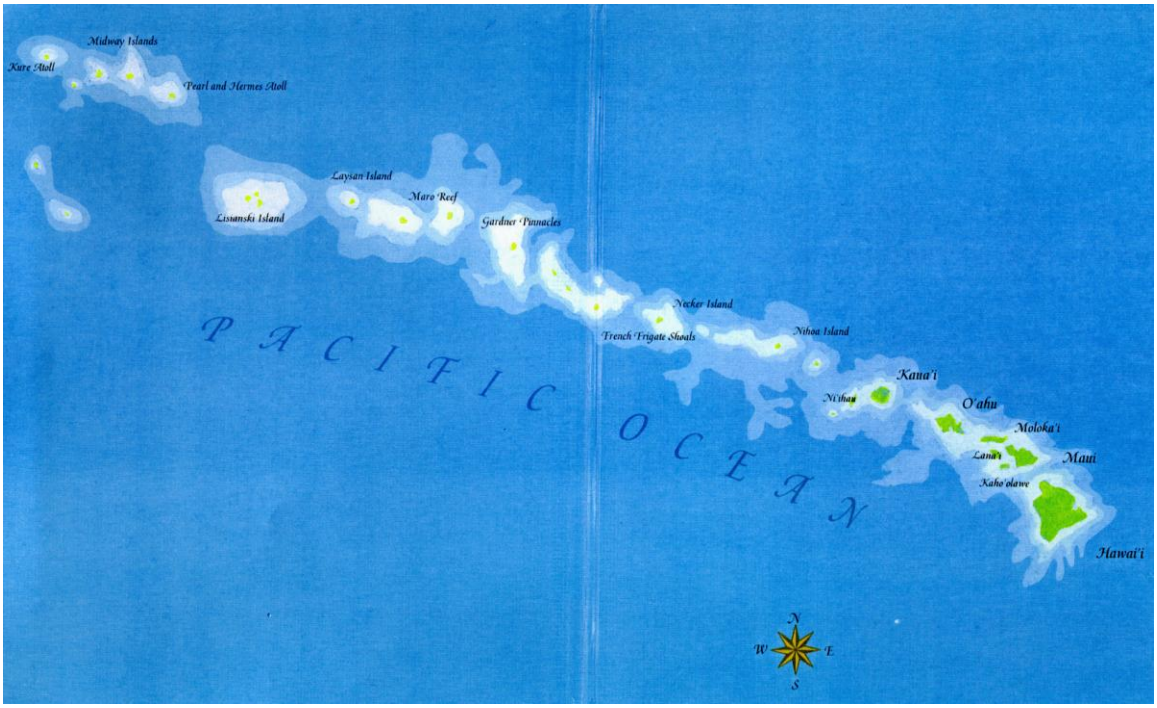
Chain of Reporting
As of 2007, most cellular phone reception does not work except at the parking area in the Kanahena area near the Ma'aonakala village site (near the "Dump"s surf break). Hence, cell phones are available for all emergency or incident situations at the education station located in this area.

## Emergency

- call 911 > Inform Education Station (if not already there) > Inform Ranger (leave message if no answer)

## Non-Emergency Incident

Inform Education Station > Inform Ranger (leave message if no answer)




**The Hawaiian Islands**

# Geology

## The "Hot Spot" Theory

The Hawaiian Islands form a chain of volcanoes which stretch over approximately 1,600 miles. According to modern geologic theory, the islands were formed, and continue to be formed, as the Pacific Ocean plate moves over a stationary "hot spot" in the Earth's mantle.[1] Molten lava rises up through the hot spot to cool in layers, eventually rising up out of the sea to form a volcano. As the ocean plate slowly moves north and west, at a rate of about 10 cm per year, it leaves behind a trail of volcanoes, with the oldest ones to the northwest, and the newest volcanoes over the hotspot. In fact, a new Hawaiian island is forming below the water as Lo`ihi seamount continues to erupt and grow. Geologists estimate that Lo`ihi will be above the ocean surface in another 10-50,000 years.

## Shield Volcanoes

The kind of magma released through the earth's crust, its temperature, and its gas content determine what kind of eruption will occur in a volcano, which in turn determines the shape of landscape which results. Hawai'i's volcanoes are made of basalt lava, which is very viscous before it hardens. The eruptions that occur from this lava are not fierce explosions like you might see at composite volcanoes like Mt. St. Helens, but rather appear as slowly spreading lava. These eruptions release lava which can travel for miles, and eventually form broad and gently sloping volcanoes. These volcanoes came to be called "shield volcanoes" because their shape

[1] In modern plate tectonic theory, the earth's crust is made up of plates that are constantly moving and shifting. The earth's mantle is the molten layer of rock just below the earth's crust.

resembles a shield. Because of the heavy weight of the lava accumulated over millions of years, the islands are also "sinking" at a rate of about one inch per year, as they compress the ocean floor beneath them.

**Life Cycle of a Shield Volcano**

Shield volcanoes develop from and erode back to the ocean floor through a variety of stages. As the magma rises up to the ocean floor, it cools and hardens in the seawater, until eventually the layers of lava rise above sea level, forming the island volcano. Forces of weather such as wind, rain, and temperature begin to erode the volcano.

As the island moves off the hot spot, lava production slows and lava cools into a cap at the summit, which seals off the peak from further eruptions. Erosion continues, breaking down rock into soil, enabling plant and animal life. Reefs grow up around the “fringe” of the volcano, in shallow coastal waters. These “fringing” reefs provide protection against erosive wave action for coastal areas, and contribute materials to build beaches.

Secondary eruptions may occur through fissures in the volcano’s sides in the “Secondary Activity” or "Rejuvenation" stage. When erosion and subsidence has removed the main mass of the volcano, the ring of “fringing” coral reef covers the remaining basalt, which forms an atoll.

As the plate moves into the colder northern waters, the reefs die, and what was once an atoll becomes a guyot. Eventually, the guyot is recycled back into the Earth's crust in a deep ocean trench located at the boundary of another tectonic plate.

**Southwest rift zone of Haleakala, including cinder cone and lava flow. (Photo: B. Burger)**

**Rift Zones**

As a shield volcano grows and adds more weight to its surface, it develops cracks in its sides to stabilize its massive weight. These cracks are called rift zones. In later stages of development, lava may be released through these rift zone cracks, providing fresh trails of lava and cinder

cones. These rift zones are like the "legs" of a tripod, which radiate out generally in three lines from the summit to help stabilize its massive weight. They can be seen easily with the naked eye as a line of pu'u or hills that run in a line down the side of Haleakala and all the way out to Molokini Crater.

**Types of Lava**

There are two kinds of lava commonly found in the Hawaiian islands. One is *a'a*, which is rough and jagged. The other is *pahoehoe*, which is smooth, billowy, and has a ropey surface. Lava that erupts in fragments small enough to drift on the wind is called ash, and may form ash cones or crescent shapes. Lava that is explosively ejected from a vent and forms pea to grapefruit-sized clumps is called cinder. Cinder may also form cones.

**The Geology of Keone'o'io**

Maui is composed of two shield volcanoes; *Haleakala* and the eroded remainder of a volcano now called the West Maui Mountains. West Maui is the older of the two, formed about two million years ago. *Haleakala* first rose out of the sea about 900,000 years ago. *Haleakala's* lava flow was so massive that it spread over to West Maui, uniting them into one landmass with the isthmus that today houses Kahului, Wailuku, and Ma'alaea.

*Haleakala* is in the "Rejuvenation Stage" of a shield volcano's life cycle. It is now 140 miles northwest of the hot spot and is considered an active volcano in an inactive state. It has three rift zones: the north rift zone extends through the Ko'olau Gap to Ke'anae Valley, the east rift zone extends through the Kaupo Gap to Kaupo Valley, and the southwest rift zone extends southwesterly from the summit and traverses down the slope to Keone'o'io. This latter rift zone is the source of the most recent lava flows on Maui, including the lava flow at Keone'o'io. There are thought to be three recent flows in this area, all originating below the upper road which connects Ulupalakua to Kaupo.

As you drive to the parking area at Keone'o'io, you drive through the most recent lava flow, which dates back to between 1480-1790. There is no recorded information of the 1790 lava flow, but this date has been estimated based on oral histories of local residents and from maps of the early European explorers.[2]

It is important for naturalists to be aware that there is a bit of debate between scientists and local peoples around when the last eruption occurred. The US Geological Survey is currently reassessing the date of the last flow due to recently obtained radiocarbon ages from the eruption zones of La Perouse Bay in 2002. Due to comparative studies with magnetic records of Big Island lava flows, these ages indicate that Haleakala's last eruption *could* have been as far back as 1480.

[2] The coastline of Keone'o'io was mapped in 1786 by Admiral Jean-Francois Galaup, Compte de La Perouse and again by Captain Vancouver in 1793. The 1793 map shows the recent lava flow, and the 1786 map does not. Hence, the date is presumed to be approximately 1790. Oral histories are recorded in Sites of Maui by Elspeth Sterling.

The source point of the most recent flow is the cinder cone known as *Kalua o Lapa* (elevation 2,660 feet), which can be seen from the road and parking area at Keone'o'io. This flow of rough *a'a* lava spreads to a width of a mile or so at the coast.

Looking southwesterly across the bay you can see Kaho'olawe, a barren red volcano mountaintop. A small population of Hawaiians formerly lived on this once forested island. It was used for ceremonies and to learn navigational skills, since it affords views of the Big Island, and even Kaua'i on a very clear day.

In the early and mid 1900's, cows and goats were raised on Kaho'olawe, denuding the land and causing erosion. This erosion problem was further exacerbated by the use of the island for nearly 50 years (between 1941 and 1990) as a bombing range for the U.S. Military and their allies. Through the efforts of The Protect Kaho'olawe Ohana and Senator Daniel Inouye, in 1993 the island was returned to the State of Hawai'i until such time as a Sovereign Hawaiian government is established.

Millions of dollars have been spent in cleanup efforts to dispose of unexploded ordnance on the island, and to revegetate the land with native species to help control further erosion. An estimated 1,880,000 tons of soil continues to be lost to erosion each year.[3] The island is being recovered for cultural and subsistence usage, and will never be commercially developed.

The smaller landform you can see rising up out of the sea is Molokini Crater. It is an example of a tuff cone that, due to prevailing northeast tradewinds, was eroded to an arc shape. Molokini Crater is a Marine Life Conservation District Seabird Sanctuary. The waters within the protected crater are a popular dive spot.

**Legends of the Lava Flow**

Ancient and modern Hawaiians alike revere a volcano goddess named *Pele*. She is known for her fiery countenance and thought to be responsible for lava flows. The ropey black *pahoehoe* lava represents her flowing hair. There are numerous Hawaiian myths and legends surrounding *Pele*.

Elspeth Sterling recounts two different legends explaining the lava flow at Keone'o'io in Sites of Maui. One legend involves a family who lived at Keone'o'io:

> The family had chickens, and would not give them to anyone until an offering had first been given to *Pele*. One day *Pele*, disguised as an old woman, approached the family asking for one of the chickens. When the family refused since the offering had not yet been made, *Pele* became enraged and chased the family. The mother grabbed her daughter and ran up the hillside while the father grabbed his son and headed for the ocean. *Pele* caught up with the mother and daughter first, seized them, split them in half and turned them into stone, creating a lava flow to engulf them forever. Next she attacked the father and son who were swimming towards the neighboring island of Kaho'olawe for protection. She threw stones at

[3] Kaho'olawe Island Reserve Commission. *Kaho'olawe Environmental Restoration Plan Draft*. (Honolulu: Kaho'olawe Island Reserve Commission, September 1997).

> them, killing them, and turned them to stone. To this day you can see two rocks offshore, representing the father and son, and you can see two great rocky projections a few feet apart where the lava flow poured forth, representing the mother and daughter.

Another legend involves two lovers, *Paea* (flint) and his sweetheart *Kalua* (the enjoyment) who came into contact with *Pele*:

> *Pele* turned herself into a beautiful woman and went to seduce *Paea*, who recognized the fiery eyes of *Pele* in the beautiful woman and refused to get involved. *Pele*, in her wrath, chased the two lovers down, killing them and turning them both into stone. Today their bodies are represented by the stones and ridges at Keone'o'io. [4]

According to other legends, the Hawaiian Islands were formed by the demigod Maui who pulled them up from beneath the sea with his magic fishhook, starting with Kaua'i first, and ending with the island of Hawai'i. The demigod Maui is also believed to have climbed to the top of Haleakala and snared the sun in a trap. This forced it to slow down as it crossed the sky, in order that the Hawaiian people would have more time to do their daytime chores and dry out their *kapa* cloth. This is how Haleakala got its name, which means "House of the Sun".

**Warnings**

The lava rocks at Keone'o'io are sharp, and can scrape and cut skin. Urge visitors to be careful when walking around the site, and to stay on existing trails.

Lava rocks do not make good souvenirs. Moving rocks or taking them from this site is illegal, and punishable by fines of up to $500.00.

Legend has it that taking *Pele's* stones can bring bad luck. The post office receives many packages each year of rocks returned to the islands accompanied by tales of misfortune. Also, many of the rocks at this site are part of archaeological ruins. Please urge people to abide by the "leave no trace" ethic:

**Take only photographs, leave only footprints.**

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**Shoreline at Keone'o'io (Photo: M. Evanson)**

# Vegetation

**Climatic Conditions**

Vegetation at Keone'o'io is well adapted to the harsh conditions there. Because Keone'o'io is on the leeward side of Haleakala, it receives little rain, and has an arid climate.

Plants in the area must survive under sun, 15-25 mile per hour afternoon tradewinds, salty air, and shallow sandy and rocky soil. The vegetation that lives there has adapted in various ways to each of these conditions. The two main habitat types at Keone'o'io are shoreline and lowland dry scrub.

**Origins of Hawaiian Plants**

There are several classifications of the plants you will find in the Hawaiian Islands.

**Endemic** plants are plants that are specific to one area, for example an island, or part of an island. Endemic plants arrived by wind and water currents, or attached to feathers of or in the gut of birds, and then evolved into unique species through adaptive radiation because of their isolation in the islands.

**Indigenous** plants occur naturally in an area, and are also found occurring naturally in other parts of the world as well.

**Polynesian-introduced** plants were brought here by Polynesians who colonized the islands (as early as 300 A.D.), and are also found elsewhere in the world. There are about two dozen in this category.

**Alien** plants are plants that arrived in the islands after European contact.

**Adaptations**

Plants at Keone'o'io are well adapted to the environmental conditions there. Adaptations are characteristics of plants and animals that enable them to better survive and reproduce in their environments. Along the shoreline you will find plants especially tolerant to salt water, sandy soils, lots of sunlight, and long periods without rain. The particular characteristics of the leaves, root systems, and seeds all enable plants in this zone to survive these harsh conditions. For example, thick fleshy leaves retain water, and vertically oriented silvery leaves reflect sunlight. In addition, long, shallow roots enable plants to maintain stability in shifting sands. Below are some of the plants that may be seen in the Keone'o'io area. Many others are found in the NAR.

***Naupaka***

Beach naupaka, or *naupaka kahakai* (*Scaevola sericea*) is an indigenous shrub found elsewhere in the tropics. It has large smooth-edged leaves and small white flowers that mature to fleshy white fruits. Its seeds are salt resistant and float like corks on water, enabling the seeds to be dispersed over wide distances on ocean currents. Hawaiians used the bark of this plant for digestion and to treat skin diseases, and ate the fruits during times of famine.

***Noni***

A shrub or small tree you may find growing conspicuously in the lava flows is *Noni* or Indian mulberry (*Morinda citrifolia*). *Noni* has large broad, dark green glossy leaves, small white flowers, and large knobby yellowish fruit that can get as big as a grapefruit. The fruits smell like Limburger cheese when they ripen! It was brought here by Polynesians and has been used traditionally as a medicine for many ailments, including: flu, rheumatism, and skin infections. Today, *Noni* is being studied by the American Medical Association and the Food and Drug Administration as a potential cure for some forms of intestinal cancer and other illnesses. It is available in most health food stores on the island, and is also sold on the mainland.

***Kiawe***

Just beyond the beach and shoreline is an area of dry lowland scrub. It is dominated by *kiawe* or algoroba trees (*Prospis pallida*), easily recognizable because they are the only trees that form a canopy along the coast. *Kiawe* is a member of the pea family, is related to mesquite, and has small paired "feathery" leaves that grow in long rows. The *kiawe* tree can drop its leaves during the dry season to conserve its energy. It has long fuzzy yellow flowers. Its light brown seedpods are a tasty treat for livestock such as pigs and cattle, and was reputedly first brought to the islands as livestock feed by French missionaries. CAUTION! It has formidable thorns that can be very painful to step on.

***Milo***

Also growing along the coast you may find the Portia tree or *milo* (*Thespesia populnea*). *Milo* can vary in size from a shrub to a tree up to twenty feet tall. It is identified by its heart-shaped leaves, yellowish flowers (with maroon centers), and woody, rounded seed capsules. The seed capsules are salt-water resistant and float, and have enabled this plant to travel throughout the Pacific, although it may have been brought here by the Polynesians. Uses of *milo* by the Hawaiians included making the hardwood into bowls, and using the seeds medicinally as a laxative. The fruits are not edible.

***Koa Haole***

Under the canopy of the *kiawe* trees you may find *koa haole (Leucaena leucocephala*). It looks like the *kiawe* but is smaller and grows in thickets. It has fuzzy white "pompom" flowers. It was also imported for livestock, because cattle especially love to eat the long brown seedpods. The seeds are used in leis.

***Naio***

*Naio* (*Myoporum sandwicense*) is an endemic shrub found from shorelines to subalpine habitats. It has dark green long leaves and white or pinkish flowers which form soft, white half-inch fruits. Also known as "False Sandalwood", its hardwood smells like the sandalwood tree.

**Castor Bean**

Castor bean (*Ricinus communis*) is a small to large shrub that grows profusely at the site. It is characterized by palmate, lobed leaves (star-shaped) with a reddish or purple tinge and reddish stalks. It has yellow flowers and greenish fruits one inch in diameter that grow along a central stalk and are shaped like burrs. Its palmate leaves help to evenly distribute heat off the plant, keeping it cool under the hot sun. Its seeds are the source of castor oil, but contain a deadly poison in their skin. DO NOT EAT CASTOR BEANS UNDER ANY CIRCUMSTANCES!

***'Ilima***

One of the smaller plants you may find under the canopy is '*ilima (Sida fallax*), a native shrub used to make special leis for Hawaiian royalty. The flower buds were used as a laxative and the bark of the tree was used to treat asthma. The plant can be either a creeping groundcover or an upright plant. You may find *pa'u o Hi'iaka* (*Jacqeumontia sandwicensis*) growing with it. *Pa'u o Hi'iaka* is an endemic morning glory with small, pale blue or violet flowers, and smooth oval leaves approximately one inch long. Its name means "skirt of *Hi'iaka*"; *Hi'iaka* is the younger sister of the Goddess *Pele*.

***'Uhaloa***

*'Uhaloa* or waltheria (*Waltheria americana*) is a small herb-like plant found growing along roadsides and in disturbed soils. It is found elsewhere in the world, and may be indigenous to Hawai'i. It has yellow flowers and silvery-ridged leaves covered with fine hairs. It was used by Hawaiians traditionally as a cure for sore throats, and is still collected for that purpose today.

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# Shorebirds

Glancing along the sandy rocks of the shore at Keone'o'io you may not at first notice that shorebirds might be living there. Well-camouflaged bodies and wings blend in with rocks and sand as the birds hunt for food in tidal pools. Below is a listing of some of the species you may encounter while you are there.

***Aeo* (Hawaiian Stilt)**

Endemic to Hawai'i, the endangered Hawaiian Stilt (*Himantopus himantopus knudseni*), has a black or dark brown back, a white neck and belly, and a black bill. It gets its name "stilt" from its long, bright pink legs which give the appearance of walking on stilts. The *aeo* grows to be about 16 inches long with a bill about three inches in length. When threatened, the *aeo* will act as though in distress, flailing around on the ground as if injured in order to lure the predator away from the nest. In groups, *aeo* will draw an intruder away from their nests by making long advances as the intruder approaches.

***'Ulili* (Wandering Tattler)**

The wandering tattler *(Heteroscelus incanus)* is a migratory bird which breeds in Northern Alaska, and winters throughout the Central Pacific islands. It is usually seen alone or in pairs, visiting the same places on a daily basis and feeding on fish and other small creatures. Its winter plumage is lead-gray in the upper body; its lower body is grayish-white. It grows to a length of about 11 inches. You may hear its high-pitched call "too-li-li-li" as it takes off in flight.

## ***'Akekeke*** **(Ruddy Turnstone)**

The Ruddy Turnstone *(Arenaria interpres morinella)* breeds in the Arctic Circle in the summer and arrives in the Hawaiian Islands in mid-August. They are distributed throughout the Pacific and other tropical regions worldwide. In the summer, the upper body is a reddish color, giving it the first part of its name, "Ruddy". "Turnstone" refers to its method of turning over stones with its bill to hunt for food. In winters they appear dark-brown with ashy markings, the throat and underparts are white, and the sides of the neck and chest are mottled with blackish-brown coloring. Its bill is blackish in color, and its legs are red.

For further reading:


Blackman, Thomas M. *Birds of the Central Pacific Ocean*. Honolulu: Tongg Publishing Co., 1944.

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**Opihi or Limpet**

# Intertidal Zone

In the zone where the sea meets the land there is a very special but often overlooked environment. In the shallow tide pools that dot the rocky shoreline at Keone'o'io you can find a great diversity of life. In what may seem a barren environment there are many creatures marvelously adapted to environmental conditions of changing tides, powerful waves, long periods under hot sun, and the constant threat of predation by animals such as shorebirds.

The Hawaiians who lived here utilized these creatures as resources for their survival, harvesting food from mollusks such as '*opihi* (limpet) and *pipipi* (nerite snail). They made use of large, hard shells for bowls and spoons, and made shell necklaces out of smaller ones. Both of these mollusks are more abundant in the NAR than most other places due to their protected status.

If you look closely at the tide pools at Keone'o'io you can find *o'opu* (jumping gobies), *ha'uke 'uke* (shingle urchins), *a'ama* (rock crabs), *loli* (sea cucumbers), pink coralline algae, *pupu kolea* (periwinkle snails), and *opihi* and *pipipi*.

***O'opu***

***O'opu* (Gobies)**

There are five species of *o'opu* in Hawai'i; four of these species are endemic, and one is indigenous. These native fish are gray and brown in color, and have a diadromous, or "two-stage", life cycle. Eggs laid in mountain streams are carried by water down to the ocean, where the juvenile fish develop. The young must return to the streams where they were hatched to lay more eggs, and sometimes that requires climbing up waterfalls! To enable them to do this, some species of *o'opu* have fused pectoral fins that form a suction cup, enabling them to climb and "hop" vertically up rocks and waterfalls. When you see them in the tide pools in their juvenile stage, they are small (only an inch or two long), and are extremely quick. If you're lucky you'll see them "hopping" over small lava rocks to get to other sections of the tide pool. As adults, the *o'opu*, depending on the species, can vary in length between five and 14 inches.

***Ha'uke'uke* (Shingle Urchins)**

Built to withstand the pounding of the waves, these tiny armored shingle urchins, called *ha'uke'uke,* have flattened spines and a strong powerful grip from hundreds of tiny tube feet. They are related to seastars. Like seastars, they have five teeth on their underside. *Ha'uke'uke* use their teeth to gather food by scraping algae off rocks. And, like seastars, their anus is on the top of their body, facing the ocean so that wastes can be carried away. Unlike seastars, urchins have spines for protection. Shingle urchin spines are flattened to withstand the force of ocean waves crashing over them. Traditionally, Hawaiians ate sea urchins, collecting them at the seashore by prying them off the rocks. Many people still eat them raw today.

***A'ama* (Rock Crabs)**

These small crabs are like SCUBA divers on land. As they scurry around on land they are able to carry water in their lungs with them, similar to how a SCUBA diver carries air. They have sharp claws at the end of each leg to help them grasp tightly onto the rocks as the water splashes into the tide pools. They shed their shells as they outgrow them, leaving behind the empty skeletons along the shore. These crabs were collected by the early Hawaiians for food.

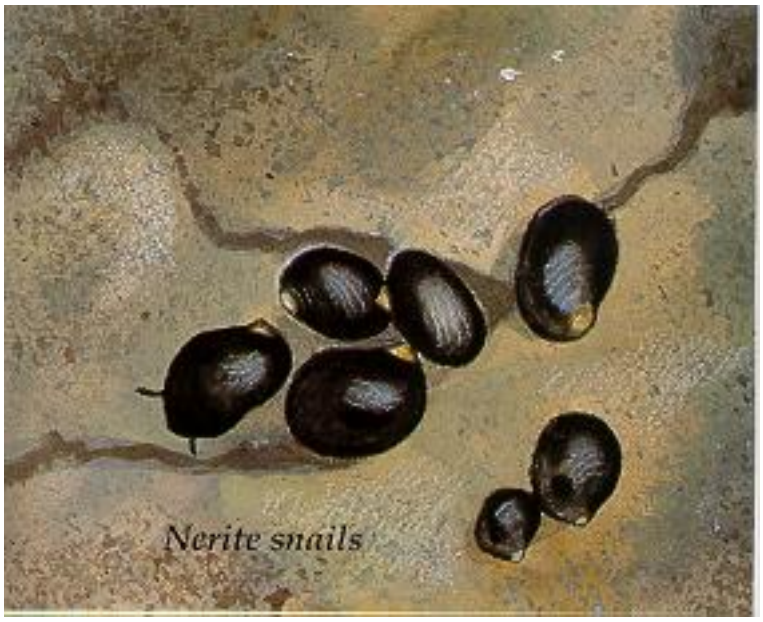
***Loli* (Sea Cucumbers)**

If you look carefully among the rocks and sand you can see three to four inch long rounded plump sea cucumbers, brown in color, lying at the bottom of the pools. Their sand-crusted skin blends in well with their surroundings, offering them some protection for their slow-moving, vulnerable soft bodies. *Loli* gather food with tentacles around their mouths. When threatened, they will shoot out white threads or even some internal organs as defenses! Luckily they are able to regenerate these organs in time.

**Coralline Algae**

Coralline algae are plants that have calcium carbonate in their structure, making them tough and "crusty". Coralline algae are the pale pink, bright raspberry and orange-colored patches you see on rocks. In the tide pools, these plants get plenty of sunlight and water and, because of their hard structure, they are not damaged by waves.

***Pipipi* (Nerite snails)**
These small black snails were also a great snack for early Hawaiians. The best place to find the *pipipi* are in crevices in the rocks, where they can be out of the impact zone of the crashing waves, and where they can hide during the hottest part of the day to avoid drying out.




***Pupu Kolea* (Periwinkle Snails)**
Feeding on the algae on the rocks are small air-breathing snails, or *pupu kolea.* To ancient Hawaiians, the soft animals living in these shells made a good snack *(pupu* means "*snack*"*)*. Protected by waves by their hard shells, these creatures have ways of sealing themselves inside their shells to conserve water and survive during low tide and long periods of hot or dry weather.

***'Opihi* (Limpet)**
You will be hard-pressed to ever see the bodies of these snails, that is, unless you are prying them off the rocks for food as the early Hawaiians did and as they and many others still do today. These small native snails adhere themselves to the rocks with a strong foot, and are usually found tucked tightly into their shells. Four of the five species found here are endemic. Look for them on rocks in the tidal zone. More abundant in the NAR than most other places, the most commonly seen species is the black-foot 'opihi (*opihi makaiuli*).

**Hermit Crabs**
Hermit crabs live in abandoned snails' shells. Unlike other crabs, the back end of their body is soft, so they need to protect it within a shell. As the hermit crab grows larger it must find larger shells to inhabit. If disturbed, the hermit crab will quickly tuck its body inside its shell, blocking off the opening with its large claw. There are six or more species of hermit crabs found in Hawai'i, and their Hawaiian names vary. Each species is distinguishable by the colors of its eyes, antennae, legs, and claws. Look closely at the beautiful colors of these crabs. Some have red eyes on green stalks, or have bright blue on their heads. People like to pull them out of the water to examine them, but should be reminded that these and all creatures should be left in place or at least returned to their places after a very quick look.

For further reading:

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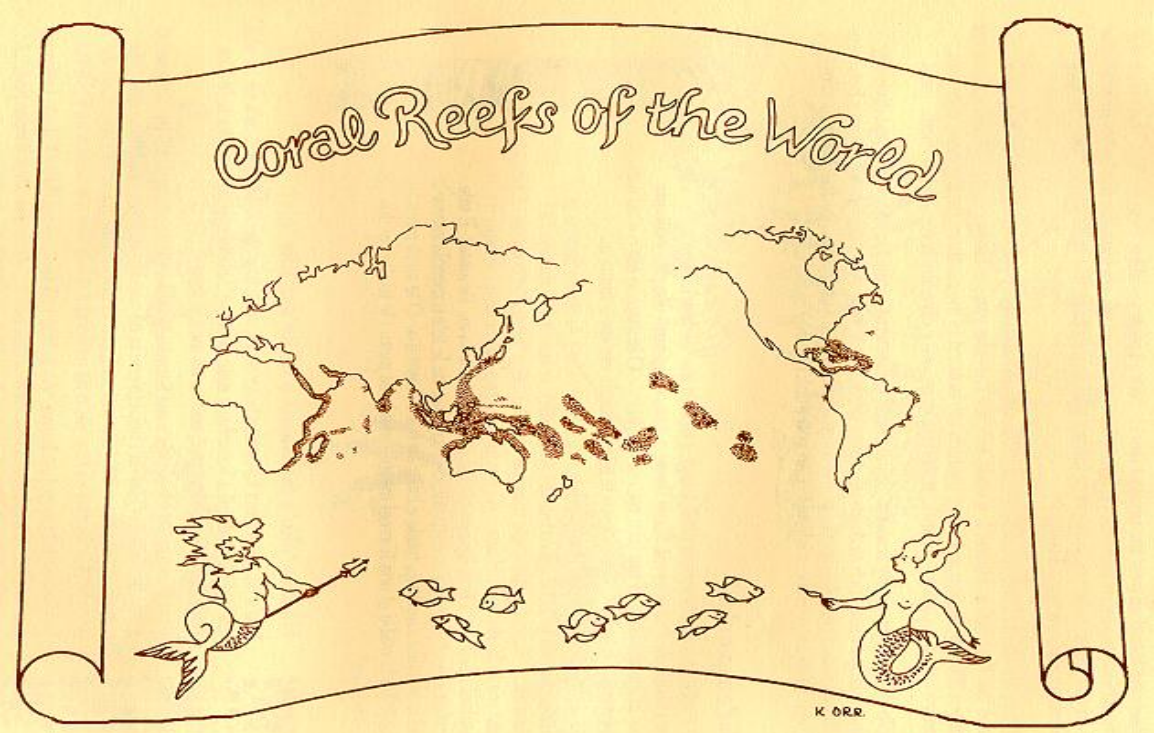


**Coral Reefs of the World**

# Coral Reefs and Reef Fish

**Fringing Reefs**

Coral Reefs on Maui are "fringing reefs", built on the shoulders of the volcanoes. At Keone'o'io you can snorkel out all along the coast and find reefs and beautiful tropical fish in their native environment.

**Mutual Symbiosis**

Coral reefs require warm, clear water, within a range of 20-23 degrees Celsius in which to live. Primitive animals called corals, related to jellyfish and sea anemones, and their single-celled plant (algae) partners construct reefs. Corals are polyps that look much like tiny sea anemone, and they feed on zooplankton (microscopic animals) in the water. These animals build their own skeletons out of calcium carbonate (limestone) with the help of algae (called zooxanthellae) that coexist inside of them. The coral provides a protected place for the zooxanthellae to live, and helps it to photosynthesize energy from the sun, while the zooxanthellae provide nutrients for the coral, and help it secrete the limestone skeleton. This kind of a win-win relationship is called mutual symbiosis.

What we see when we look at a coral reef are layers upon layers of the fused and compacted skeletal remains of dead coral, while the live "colony" lives on the uppermost surface of the reef. It is the presence of the algae which gives the coral its color. When a coral becomes stressed, it may expel its plant partner, and lose its color, appearing "bleached". This is what is referred to as "coral bleaching", a problem occurring in reefs around the world today because of pollution and global warming.

There are many different species of coral, each diversified in their need for light, space, temperature, and nutrients. Cauliflower coral, False Brain coral, Lobe coral, and Antler coral are all types of coral you may find in the waters at Keone'o'io.

**Protecting the Reef**

Hawai'i's coral reefs grow very slowly—only about a quarter of an inch per year, and so take a long time to recover from damage. The coral is very sensitive to disturbances, and can be easily damaged when people hold onto it, stand on it, kick or bump it, or drop things like anchors onto it. Rainwater runoff can carry with it pollutants from golf course fertilizers and other human-introduced chemicals that can damage and destroy life on the reef. Storms can wash sediments downhill to the ocean which settle onto the coral, blocking out sunlight and eventually killing it.

**Hawai'i's living reefs are protected under state laws. It is illegal under State law to take dead coral, or to take, break, or damage any live coral, or any coral with marine life attached to it, from waters less than 90 feet.**

It is our responsibility to future generations to alert visitors to the fragility of these reefs—and to stop snorkelers from causing damage to the coral. Please let them know the reef is alive, and can be damaged when it is handled or stepped on. People can suffer nasty cuts and scrapes from it, and these cuts can easily get infected. It's better for everyone that we use a hands-off approach, and enjoy these amazing creatures with our eyes.

**Adaptive Radiation**

Coral reefs provide a variety of food and habitats for many fish and invertebrates in the near-shore waters. As with everything that exists here in Hawai'i, the big question is: How did it get here?

It is impossible for small tropical fish to swim the 2,000 or more miles from other reef ecosystems, and so scientists believe the fish found in Hawai'i's reef ecosystems may have floated on ocean currents when they were in their larval stage. Scientists theorize that because of Hawaii's isolation, the original colonizers were not joined by other species for, (on average) thousands of years. Therefore, the colonizing species had plenty of time without competition to allow them to radiate into many niches, become isolated from the parent species, and through genetic mutations and natural selection, evolve into new species found nowhere else on the planet.

Yes, you will find damselfish in other parts of the world, but not specifically the domino damsel or *'alo'ilo'i* (*Dascyllus albisella*). And there are other angelfish in the world, but not our bandit angelfish *(Desmoholacanthus arcuatus*). Look for them when you're out on the reef.

**Survival Strategies**

Reef fish have their own strategies for survival. For example, surgeonfish have sharp spines to protect them from being handled, caught, or swallowed! Some fish, such as *'u'u* (soldierfish), use protective coloration to blend into the reef. Although they are bright red and may not appear to blend in, red is the first color of the light spectrum to fade with depth. At 20 to 30 feet, red turns to gray, and soldierfish all but disappear. This camouflage helps soldierfish to sneak up on their prey, and also to avoid being eaten.

Other fish, like the *humuhumu-nukunuku-apua'a* (reef triggerfish), chosen as the Hawai'i state fish in the 1980's, relies on a head spine to wedge themselves tightly into crevices so that predators cannot pry them out. The ‘*uhu* (parrotfish), excretes ground reef rock, and creates a "sleeping bag" of mucous each night to keep predators at bay.

**Early Hawaiian Uses and Conservation**

Early Hawaiians relied heavily on marine resources for food, tools, materials, and medicine. Fish were probably one of the most important foods in the Hawaiian diet. Many different kinds of fish were eaten, and there were many ways to catch them. Schools of *manini* (convict tang) were caught using nets made from the strong fibers of the *olona* plant, and then laid out in the sun to dry, and preserved in salt. *U'u* and *aku* (skipjack tuna) were caught from fishing out of a canoe using hooks made out of bone, wood, oyster shell or turtle shell. Fishermen caught *he'e* (octopus) by lowering a *leho* (cowry snail) shell lure in front of an octupus den.

Hawaiians regulated the use of these resources through strict laws called *kapu*. People who disobeyed *kapu* were usually put to death. These *kapu* regulated the type, size, and amount of fish that could be caught. Some varieties of fish were reserved only for *ali'i* (royalty). Fish were also left at shrines as offerings to certain gods. People today still rely heavily on the marine environment for sustenance, and we can learn from these great conservationists who practiced sustainable harvesting techniques.

**Fish Feeding**

Many people think it's fun to feed the fish. Although it may seem harmless, feeding fish can be very damaging to the fish and to the reef, and in some cases it can be damaging to snorkelers as well.

Feeding fish can cause changes in fish behavior, cause schooling, create competition, and cause overgrazing of the reef. When fed, even nocturnal fish will risk coming out during the day. In addition, human food may be harmful for fish to eat. Any change in fishes' behavior can alter the fragile balance of the reef ecosystem and be detrimental to the system as a whole.

When people feed fish, they miss seeing fish do what they normally do.
When fish associate humans with food, they may get too close and even bite. A slash from a surgeonfish's tail can require dozens of stitches!

So when people ask you about snorkeling, encourage them to be safe – safe for themselves and safe for the reef. Remind them:

**No fish feeding.**

The best way to experience the magical wonders of the reef is to relax and enjoy your encounters with creatures in the wild on their own terms.

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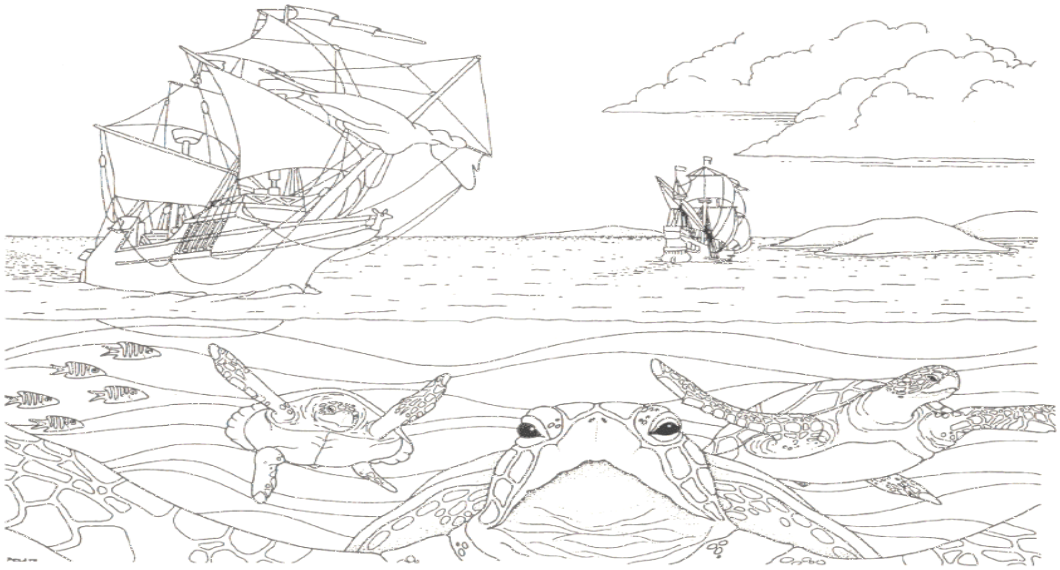
# Sea Turtles

There are five species of sea turtles found in Hawaiian waters: Olive Ridley, Loggerhead, Green, Hawksbill, and Leatherback. Of these, only the last three are found with regularity. Turtles have always been important in Hawaiian culture. Their images grace petroglyphs and they appear in Hawaiian history as ‘*aumakua* (family gods or guardians). Turtles were hunted for food in Hawai'i until protected under the Endangered Species Act in 1976.

***Honu* (Green Sea Turtle)**



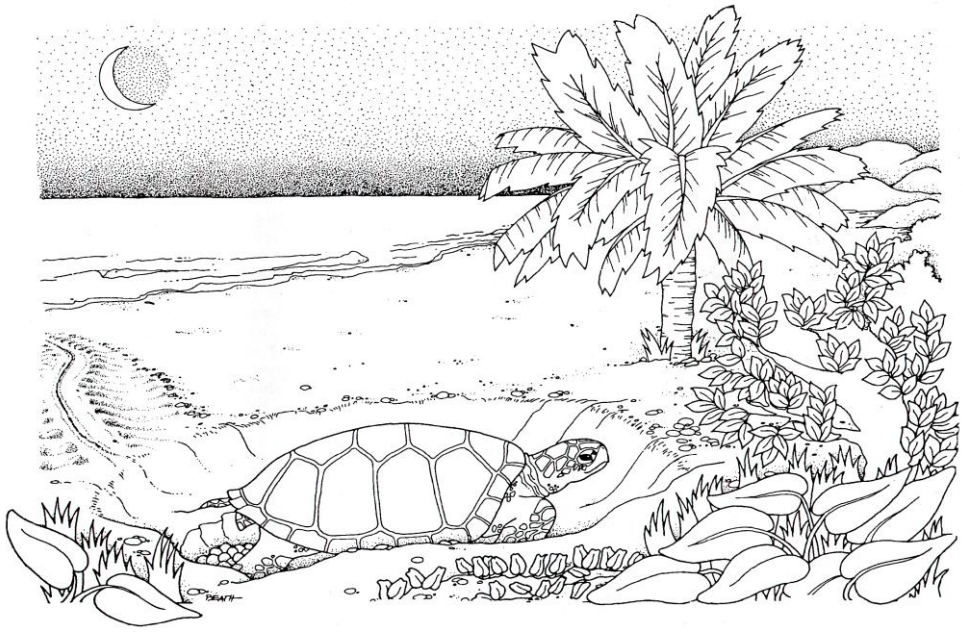
**Green Sea Turtles**

The turtle most popularly seen in Hawai'i is the *honu (Chelonia mydas)*. These green sea turtles can grow to be four feet long, weigh 200 or more pounds at sexual maturity, and live 80 to 100 years (some may weigh as much as 400 pounds!) They grow slowly, reaching sexual maturity at an average of 25 years. You can see them just offshore, bobbing their head above water to take a breath of air before they dive again. *Honu* feed primarily on *limu* (seaweed), which grows on coral reefs and underwater rocks, and come to the surface to breathe about every 15 minutes. When green sea turtles are resting they can hold their breath underwater for 2-3 hours.

Once every 2-5 years, female green sea turtles migrate 600 miles to the northwest to the French Frigate Shoals (part of the Northwestern Hawaiian Island chain) to nest on the sandy beaches. They crawl up on the beach at night and deposit 100-200 leathery, golf ball sized eggs. Scientists studying these events estimate that only one in a thousand hatchlings will reach sexual maturity.

More than twenty years ago *honu* were over-harvested because of their delicious meat. Today, they are a threatened species in Hawaii, and an endangered species in other parts of the world. Green sea turtle soup and turtle steak were popular menu items in Hawai'i and other parts of the world until 1976 when green sea turtles were officially protected by the Endangered Species Act.

Although the numbers of green sea turtles have been increasing in recent years in Hawai'i, some are suffering from fibropapilloma, a virus that produces tumors on the turtle's head and/or flippers. Tumors growing near the eyes can prevent turtles from seeing. As the disease progresses, fibropapilloma eventually causes death.



**Green Sea Turtle nesting**

**'Ea or *Honu'ea* (Hawksbill Turtle)**

*'Ea* or *Honu'ea* (*Eretmochelys imbricata)* have beautiful shells that were made into 'tortoise shell' sunglasses, combs, and other luxury products until the turtles became protected under the Endangered Species Act. *Honu'ea* grow to be just less than 3 feet long, and weigh up to 200 pounds. *Honu'ea* were not often eaten because they feed on toxic sponges that makes their meat poisonous to humans. Although now protected, there are very few Hawaiian hawksbill turtles left. They nest on isolated beaches on the Big Island, Moloka'i, O'ahu and on Maui.

The turtle crossing signs on the way to Ma'alaea Harbor are meant to protect Hawksbill turtles. Hawai'i Wildlife Fund organizes a turtle watch every summer to locate and monitor nesting turtles. Nest watchers protect the nests until the hatchlings emerge and make their way to the ocean. Losses of nesting habitat and interference of lights at night near the nests continue to threaten the survival of the *honu'ea*.

**Leatherback Turtle**

The leatherback turtle *(Dermochelys coriacea)* can grow to weigh 2,000 pounds and 8 feet in length, making it the world's largest turtle. It's called a leatherback because instead of a hard shell it has a leathery one. This species is found in deeper, offshore waters, so is usually only seen by fishermen. The leatherbacks feed primarily on Portuguese Man-o-War, and are immune to their sting. Leatherbacks don't commonly nest on Hawaii's beaches, but one nesting female was documented on the island of Lanai in 1997.

**Protecting the Turtles**

All sea turtles are protected under the Endangered Species Act and wildlife laws of the State of Hawai'i. It is illegal to capture, kill, harm, or harass sea turtles. The recommended viewing distance for observation of sea turtles is 50 yards.

Please encourage people to look at but not to touch the turtles. Touching them, grabbing them, or attempting to go for a ride is against the law, and can cause harm to the animals. Instead, encourage visitors to give the turtles room and enjoy watching their natural behaviors from a safe distance. If you should witness someone breaking the law, please record the incident with as much information as you can, and alert the volunteer coordinator.

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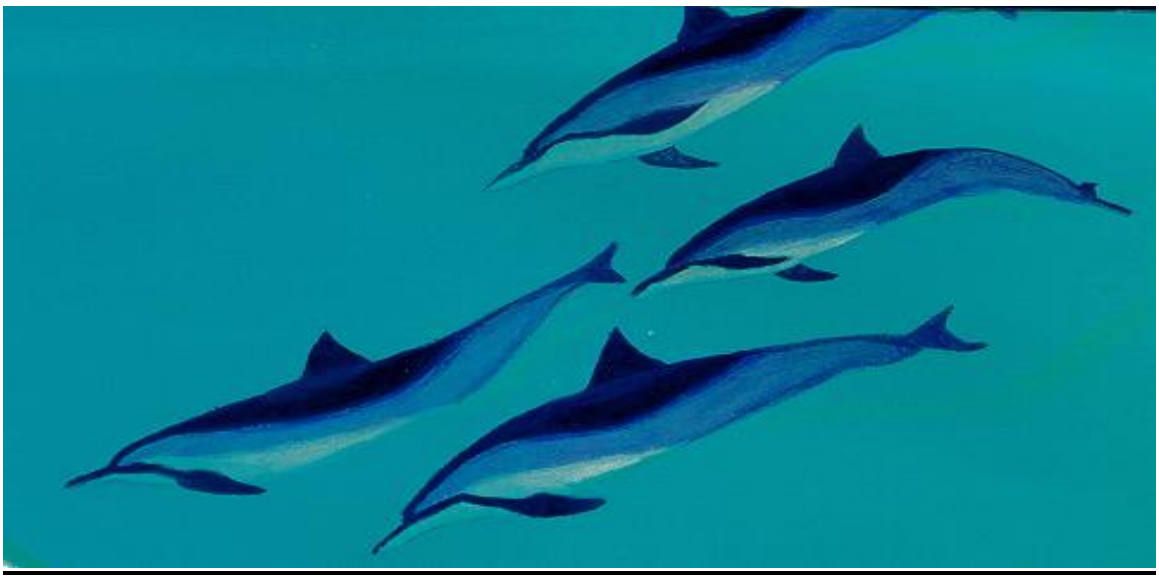

**Pod of Dolphins**

# Hawaiian Spinner Dolphin

The Hawaiian Spinner Dolphin (*Stenella longirostris*) is a population or stock of dolphins unique to Hawaii. They can be easily identified by their three-tone color pattern and high twirling leaps into the air. They are warm-blooded, breathe air, and give birth to and nurse live young. They are the smallest of Hawaii's three resident dolphin species, measuring four to seven feet and weighing between 100 and 165 pounds. Spinner dolphins are pan-tropical in distribution, with different forms found in different geographical locations.

**The Toothed Whales**

Dolphins are in the order Cetacea, an order that includes all of the whales, dolphins, and porpoises. Cetacea are then separated into two large suborders: toothed and baleen whales. Baleen whales, like the humpback, have large baleen 'plates' that hang from the roof of the mouth and act as giant strainers for the zooplankton and small fish they eat. Dolphins are toothed whales. Their cone-shaped teeth are very sharp and are designed to grab the live fish and squid on which they prey.

**Social Behavior**

Hawaiian spinner dolphins are social animals, living in groups (pods) that may include hundreds or even thousands of members. Groups provide safety, social opportunities, and training for young dolphins.

Spinner dolphins are nocturnal feeders. They feed in the open ocean from dusk to dawn, often near ocean ledges, diving up to 600 feet to feed on lantern fish, squid, and small hake. During the day they find shallow, sandy bays in which to rest and recover from the activity of the night before.

While hunting groups can be quite large, resting groups tend to split off from larger groups into pods of 30 to 40 dolphins. Resting pods do not always contain the same individuals each time.

Keone'o'io is often used as a resting bay by pods of Hawaiian Spinner dolphins. In sandy bays like Keone'o'io, spinner dolphins can more easily stay in visual contact with one another, and can keep an eye out for predators such as sharks. The time they spend resting in the bay is essential for their health and survival.

**Echolocation**

Dolphins and other toothed whales have a very sophisticated 'hearing' sense called echolocation. It's the same ability bats have to locate their prey in the dark. Dolphins send out a series of clicks and whistles, emitted through their 'melon' or forehead. These sound waves bounce off the object and return to the lower jaw, giving the dolphin a very precise picture of what lies ahead. From the information they receive, they are able to determine not only the size and shape of the object, but also how far away it is, and how quickly and in what direction that object is moving.

Considering that the deep open ocean is a large area in which to search for food, the ability to use a string of clicking noises to locate prey is invaluable. Scientists have found that spinners can locate an object the size of an orange up to 370 feet away! This echolocation is not only helpful in locating prey, but also in stunning prey, getting information about their surroundings, keeping track of the location of other dolphins, and avoiding predators.

**Why do they Spin?**

Scientists do not understand why spinner dolphins spin. Spinning could be a form of play, or a way to dislodge parasites from the body. Recently, scientists began to postulate that the trail of bubbles left by the tail swirling in the water could be 'seen' by other dolphins' sonar and that the trail might be a form of communication. Scientists also speculate that the spinning dolphins are sending auditory messages in the form of loud slapping sounds made when the spinner's body hits the water. Specifically, they may be relaying information about the size and shape of the pod –- acting as a kind of 'border patrol' to let the individuals know whether they are safely within the group boundary.

**Resting Behavior**

Like all toothed whales, the spinner dolphins have one blowhole on the top of their head. (As opposed to two blowholes in baleen whales.) Dolphins (and all marine mammals) are voluntary breathers and must 'think' in order to take a breath. For this reason, the dolphins don't go to sleep in the way we do. Instead, they rest. Hawaiian spinner dolphins' rest periods are characterized by an alpha (rest) state that allows vital areas of the brain to be dormant. Closing one eye, dolphins can rest one hemisphere of their brain while the other half remains alert. During rest, dolphins don't echolocate regularly and may rely on maintaining visual contact with each other to avoid predation.

You can easily spot resting behavior at Kenoe'o'io. About 100 yards offshore past the coral reef there is a sandy strip where the dolphins can often be seen. Look for sets of dorsal fins appearing just above the surface of the water. There will be very few, if any, aerial spins, and the animals

will engage in slow, synchronized swimming, coming to the surface to breathe in pairs of two or more.

Spinner dolphins may arrive in the bay in the early morning, engage in resting behavior most of the morning, and move out of the resting period by mid-afternoon. The end of the rest period may be characterized by increased activity, by spinning leaps, and by what is called 'zigzag swimming'. During this period, some of the dolphins will swim faster, and slap the water with their bodies. These more active dolphins will start to swim out to open water. Since the majority of the group is still resting, the more active dolphins will turn back toward the bay, gather up more members that have 'awakened', and once again charge out to sea, doing this back and forth movement until the whole pod is ready for another foray to the deeper hunting grounds.

Pods move out of the shallow bays into deeper water, joining up with small pods from other bays to form a larger hunting pod. These large pods then spread out, and hunt throughout the night.

**Reproduction**

Female spinner dolphins mate all year long, and during this time they will mate with many males. Although most births occur in the summer and fall, births can occur year-round. The young are born live, tail first, and quickly rise to the surface for their first breath of air.

**Human Impacts**

Many dolphins (between 300,000 and 500,000) were killed as a result of the tuna fisheries from the 1950's through the 1970's, and thousands of dolphins still die today from that practice. Luckily, Hawaiian spinner dolphins do not swim with tuna and have not yet been affected by tuna fishing practices. Over-fishing depletes the dolphins' food source, and net-fishing techniques can cause entanglement and drowning of dolphins.

A new issue arising around the world, and at Keone'o'io, is the issue of dolphin harassment from people swimming with dolphins. At the site you can often see dozens of snorkelers, kayakers, and professional boat operators in the bay, all endeavoring to swim with the dolphins when they are there. More research is needed to determine the impact these behaviors may have on the dolphins. Observations gathered in this naturalist program may help us gain a better understanding of this issue.

**Laws and Definitions**

Dolphins are protected by the Marine Mammal Protection Act. Under the provisions of this act, it is unlawful to harass, hunt, capture or kill any marine mammal, or attempt to do so. The language of the law is vaguely written such that "harassment" includes any activity of "pursuit, torment, or annoyance which has the *potential* (author's emphasis) to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns including, but not limited to: migration, breathing, nursing, breeding, feeding, or sheltering".[5]

[5] Hawaiian Islands Humpback Whale National Marine Sanctuary, *Hawaii's Ocean: Users Handbook* (Honolulu: U.S. Department of Commerce), 6.

Under this definition, swimming with dolphins as it happens at Keone'o'io may constitute harassment under the definition of this law. The distance guideline determined by the National Marine Fisheries Service for dolphin interactions is 50 yards.

Dolphins' resting time is critical to their survival. Just as with any other species, lack of rest means lack of energy, energy that may be essential in warding off an attack by a predator later in the night. During their critical resting time, they depend upon tranquil conditions, just like everybody else when they are trying to rest.

Even those people with the best intentions may be 'harassing' the dolphins if they approach when the dolphins are trying to rest. Many people are not aware that the dolphins are actually resting and are best left undisturbed. It's important to remember to let the dolphins initiate the encounter.

The best thing that we can do for the dolphins is give them the space and the rest that they need to thrive, so that their populations stay strong for future generations to experience as well.

**The best method to use to avoid engaging in harassment is to stay 50 yards away, and let the dolphins make the approach.**

If you see a flagrant case of harassment, please record this with as much accuracy as you can, and communicate with the volunteer coordinator immediately.

<u>For further reading:</u>

Norris, Kenneth. *The Hawaiian Spinner Dolphin*. Berkeley: University of California Press, 1994

**Hoapili Trail through Keone'o'io (Photo: M. Evanson)**

# Archaeology

**Ancient History**

Hawaiians lived at Keone'o'io for approximately 600 years before the arrival of Europeans. They lived in villages made of structures built on and from the lava rock. Some of the foundations of the village buildings are still standing today. While a complete picture of life in these villages is not known, oral tradition, European accounts, and archaeological investigations provide some pieces of the puzzle.

At Keone'o'io, you can see remnants of rock walls and foundations from some of the *hale* (houses) that the Hawaiians built. The area also includes *kauhale* (residential compounds with several hale), *heiau* (temples), burial cave sites, fishing shrines, canoe sheds, and the Hoapili Trail, which extends from Lahaina to Hana. If you look carefully, you can see wells, storage structures, an adze site, terraces and mulch pits for planting, and a fishpond along the shoreline at the northern end of the bay. In all, there are over 75 archaeological features in the site.

It is not known with certainty how old these sites are. Other settlements along the southeast coast date to as early as 1100 A.D. Keone'o'io is associated in oral traditions with *Kauholanuimahu*, a ruling chief from the island of Hawai'i, who lived at the site at various times during his reign in the 1400's or 1500's.[6] These stories establish that the site was inhabited around 500 years ago. Archaeological research from the other districts in the area suggest that in general, the southeast region was settled sometime after the 13th century, when the islands' population began to expand rapidly.[7]

**European Contact**

[6]Fornander, Abraham. *An Account of the Polynesian Race: Its Origins and Migrations and Ancient History of the Hawaiian People to the Times of Kamehameha I*. (Tokyo: Charles E. Tuttle Company, 1969), 71.
[7]Kirch, Patrick Vinton, *Feathered Gods and Fishhooks*, (Honolulu: University of Hawaii Press, 1996), 138.

The first European to make mention of the site in written documentation was French explorer Admiral Jean-Francois Galaup, Compte de la Perouse, who anchored in the bay on May 30, 1786. Upon entry to Keone'o'io there is a monument made of lava rock. The plaque on it states:

> On May 30th, 1786 French Admiral Jean-Francois Galaup Compte de LaPerouse, commanding the two frigates La Boussole and L'Astrolabe, was the first known European navigator to land at Keone'o'io also called La Perouse Bay on the island of Maui. (The sign was placed there by the French organization "Friends of LaPerouse.")

Admiral La Perouse reported upon arrival that the Hawaiians "hastened to come up to the ships in their canoes", bringing taro and bananas, *kapa*, and other "curiosities forming part of their attire". He reported that the villagers gave him the gift of a pig, and he in return gave them "axes and pieces of iron which were for them gifts of inestimable value".

His account of what he saw is as follows:

> The soil of this land is entirely formed of decomposed lava and other volcanic substances. The inhabitants have no other drink but a brackish water, obtained from shallow wells, which afford scarcely more than half a barrel a day.
>
> During our excursion we observed four small villages of about ten or twelve houses each, built and covered with straw in the same manner as those of our poorest peasants. The roof has a double slope, the door which is in the gable end is about three feet and a half high and consequently cannot be entered without stooping, and is shut by a simple latch which any one can open and obtain admittance. (M. Dondo, La Perouse in Maui, p. 43.)

**Ancient Land Management**

Pre-contact Hawaiian culture had developed into an elaborate hierarchy of governance. Islands were *moku*, independent chiefdoms divided into districts made of *ahupua'a*, wedge-shaped land units which generally ran from forested uplands near the volcano's summit, down through agricultural lands to the coast and out into the sea. This type of land division ensured access to all the land's resources: the mountain streams for fresh water, the good agricultural soil and hunting in the mountains, as well as access to all the resources of the sea, including *limu* (seaweed), shoreline crabs and snails, fish, *he'e* (octopus), and *mano* (sharks) in the ocean.

*Ahupua'a* were controlled by lesser chiefs who governed their usage. *Ahupua'a* were divided into '*ili* and *mo'o*, smaller land units which families or groups could work. Keone'o'io is part of the *Honouau'ula* (red earth) district, and part of the *Kalihi ahupua'a*, which runs from Haleakala's crater along the southwest rift zone down to the sea.

In the extensive class system, which existed in the 1800's, commoners gave chiefs tribute and labor in exchange for the right to live on and grow and obtain food from the land. The *ahupua'a* is said to have been created approximately 500 years ago.[8] The pie-shaped boundaries of the

[8] Sterling, Elspeth, *Sites of Maui* (Honolulu: Bishop Museum Press, 1998), 3.

*ahupua'a* are still recognized today, although they are no longer used for land management. After the "Great Mahele of 1848" (the distribution of land from the Hawaiian king to individuals, including foreigners), the land ownership system changed to the fee simple system we have today.

**Village Life**

In pre-contact Hawai'i, villagers cultivated crops of taro and sweet potato, harvested the ocean waters for fish and other sea creatures, raised pigs, dogs, and chickens for food, and raised mullet in fishponds. Depending on a family's status, they lived either in compounds with many houses included, or they lived in one simple house. They fashioned tools out of shells, bone, and lava rock.

According to a classic archaeological text on Maui:

> House platforms or enclosures generally had outside terraces that served as lanais, which may or may not have been covered. In the case of the more pretentious dwelling sites, several house platforms and enclosures might be included within the surrounding walls of a single establishment. Fire pits were found inside many house sites in various locations, but all fireplaces in the larger dwelling sites were found in separate enclosures in which all the cooking was done. Large smooth water-worn stones were used as weights to keep the rolls of bed mats in place during the day, and may have answered for pillows at night. It is not likely that they were used as seats as even present day Hawaiians prefer to sit on the ground or the floor. Stone lamps for burning the oil of the kukui nut were household utensils as well as the more common stone anchors, sinkers, and cowry-shell lures for fishing. (W.M. Walker, Archeology of Maui, pp.66-71)

There is a crème-colored sign in the current main parking area. It states:

> For 600 years, Hawaiians lived here in the village of Keone'o'io…how did they do it?
>
> On this lava rock landscape, people worked together. Well-groomed paths tied households to each other, and to upland fields and forests. People fished. They hauled in soil to grow plants for food, medicine and tools. For water, they dug shallow wells in the *a'a* (loose lava). At *heiau* (stone shrines or temples) they made offerings to their gods.
>
> Most of the stone enclosures, pavings or platforms you see here are remains of *hale*- thatched shelters where people of Keone'o'io slept, ate, worked, or stored their canoes. The raised stone platform by the sea is one kind of *heiau.*
>
> Photo caption: Women plaited *pandanus* (screw pine) mats to cover floors and sleeping platforms. For long walks over rough lava, they wove sandals from leaves or bark.

Please *kokua!* --Help protect this place! Walk only on obvious paths, and leave every stone and pebble in its place. Keone'o'io is a 65-acre Hawai'i Historic Register District. Disturbance of historic sites is punishable under Hawai'i law. (This sign is a community project of the South Maui Heritage Corridor Action Committee supported by the County of Maui, Office of Economic Development; State of Hawai'i, Department of Business, Economic Development and Tourism (DBEDT); and Tri-Isle Resource Conservation and Development Council, Inc.)

**Canoe Sheds**

There are several canoe sheds on the site, distinctive because of their elongated shape and proximity to haul out places along the shore.

**Canoe shed at Keone'o'io (Photo: M. Evanson)**

**Salt collecting pans or adze grinding site (Photo: M. Evanson)**

**Salt Collecting Pans or Adze Grinding Site**

Farther down the four-wheel drive road, along the shore, there is a large slab of *pahoehoe* lava with many circular indentations on it. This may be an adze-grinding site, where craftsmen would sharpen axe-like tools called adzes, which were made out of a harder lava rock found in certain areas of the island. These tools had many uses, including tree-felling and making fishhooks out of shell and bone. The depressions may also have served as saltpans for evaporating seawater to get salt. Salt was used for drying food, especially fish.

**The Fishpond**

The Keone'o'io fishpond is on the shore at the border of the land with the adjacent private property. It comprises most of the little bay to the northwest of the parking area, and looks undeveloped. But at one time a stone wall extended about 200 feet across the channel. It was damaged by a tsunami and never repaired. Today there are only a few remnant sections of the wall that are visible. (The fishpond is privately owned and trespassing is prohibited.) The fishpond is attributed to *Kauholanuimahu*.[9]

***Heiau***

*Heiau* were places of formal worship for the Hawaiians. Shrines were places of less formal worship, and were often associated with a house or family. At Keone'o'io there are at least two *heiau*: one is just several yards away from the current parking area. It is called *Paalua Heiau*, and is devoted to both fish and rain. There is also reported to be a *heiau* for a shark, called *Hala Heiau*. This *heiau*, located 300 yards to the west of *Paalua Heiau*, is in the form of a rock with an elongated indentation in it. [10]

[9] *Ancient History of the Hawaiian People to the Times of Kamehameha I.* 71.
[10] *Sites of Maui*, 223.

**Protecting the sites**

You can clearly see that the sites of Keone'o'io are a rich and special historical treasure. People have already destroyed some of these sites, either maliciously or through ignorance, by taking rocks, dismantling the sites for other uses, and walking through and driving over them.

Here are a few tips you can pass on to visitors for how to behave around these sacred and fragile archaeological sites. This excerpt has been taken from Legacy of the Landscape, by Patrick Vinton Kirch:

- Above all, keep in mind that these sites represent the cultural heritage of the native Hawaiian people, and as such deserve great respect. This is especially so for religious sites, such as the various *heiau* or places of worship...Prior to the abolition of the *kapu* system (strict rules)...many of the *heiau* were highly sacred places, which only the high-ranking chiefs would enter. Even after the traditional rituals were no longer practiced, these sites continue to be regarded as *wahi pana*, or sacred places. They are imbued with *mana*, or spiritual power, and continue to have great significance to the native Hawaiian people.
- Remember at all times that Hawaiian archaeological sites are fragile constructions. The stone walls and terrace facings that make up many sites were laid without the use of mortar and can easily tumble or collapse. The walls enclosing *heiau* and house sites were never intended by their makers to be walked upon, and visitors should keep off such constructions at all times. Many sites have foot trails designed for visitors—please stay on these and observe all signs.
- Never remove anything from an archaeological site; removing stones or artifacts is not only immoral, it is illegal as well. If you should happen to observe an artifact or other culturally significant material on a site (for example, exposed by erosion), leave it in place and report your observation as soon as possible either to the ranger or staff person in charge of the site, or to the local office of the State Historic Preservation District.
- Do not rearrange or modify an archaeological site in any way. This includes the regrettable practice (increasingly common) of wrapping ki-leaves as informal offerings...Contrary to popular belief, this practice is not a part of traditional Hawaiian ritual (although the use of ki-leaves in ritual is an ancient Polynesian practice), and only leads to the rearrangement of paving and wall stones, thus destroying the integrity of the archaeological remains.

Help the visitors to *malama* this special treasure by sharing with them how fragile the archaeological sites are, and by encouraging them to preserve the site for others to visit in the future. Ask them to treat the area with respect by staying on existing trails, and observing the sites from the trails. Remember:

**Take only photos, leave only footprints!**

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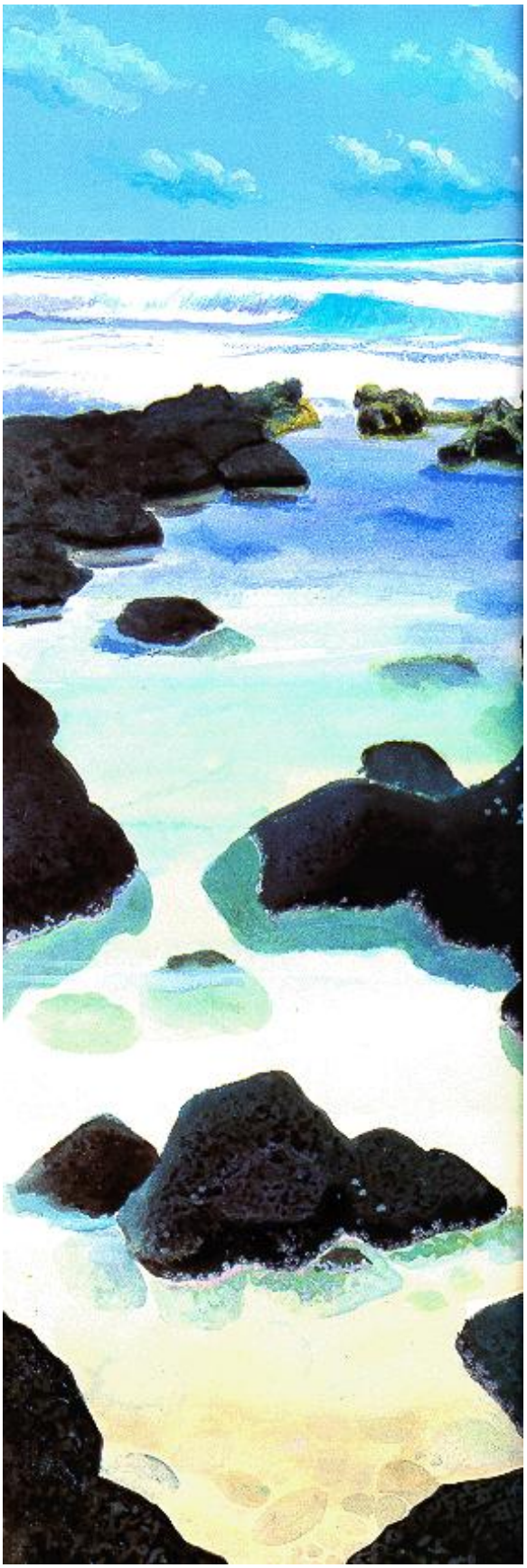

# On Being a Naturalist

The most important quality of being a naturalist is probably not how much you know about the environment, or how much scientific information you have; it may well be how much you enjoy learning and making discoveries about the place, and how much you enjoy sharing that with others.

**The Sense of Wonder**

Rachel Carson, in her book The Sense of Wonder, describes a process by which children gain a respect and love for nature. She states that it is through the caring witnessing of an adult that children arrive at meaningful learning and appreciation of the world around them. Most visitors to Keone'o'io are adults, but they still can be awakened to a new sense of wonder through your sharing with them.

The best way to do this is to keep this sense of wonder alive in you. Take from this manual what interests and inspires you the most, and use it as a starting point for your own discoveries about Keone'o'io. With your own inspired research and discovery you can add to the knowledge about this place, share it with other naturalists, and make the naturalist program even stronger.

**Teaching Styles**

The naturalist program at Keone'o'io is an informal program—the educational style you ultimately use with visitors at the site is up to you. There are many ways to create a positive learning atmosphere, one that is fun, thought provoking, and sensitive. We recommend that you do what is most comfortable for you, but also keep in mind the following suggestions:

When dealing with visitors, start with what interests them. They may approach you with a question about the coral, or about the archaeology. Use this as a starting point to meet them where they are at, and then expand your conversation from there. For example, if they ask you about

the snorkeling, you may ask them what they've already seen, where they've been, and what they like to see the most when snorkeling. You can then talk with them about the different adaptations of creatures living in the reef, how the early Hawaiians used the resources there, or how they are still used today. This could eventually lead to a discussion about the archaeology of the place, or other marine mammals you may see while in the water.

Asking questions is a great way to get things rolling, either to initiate a conversation or to continue one. "Did you see any dolphins out there yet?", "Ever seen an ancient Hawaiian village?" and "Do you know what a limpet is?" are the fun kinds of questions that can get people's attention and curiosity going. Use questions to stimulate people's thinking and awareness about the natural world around them.

Another good technique to use is to teach about what is immediately around you. For example, if a dolphin makes a spinning leap just offshore while you are talking with a group, take that opportunity to focus the group's attention on Spinner dolphins. People will remember much more about the wonders of Keone'o'io if they learn about them as they are experiencing them.

**Learning Styles**

The other major concept to understand about being a naturalist is that people learn differently. Most people are visual learners, and do well when they see something drawn out before them. Other people are auditory learners and understand by hearing about a thing. Others may be kinesthetic and need to touch it to really know it. Remember when dealing with people that you may need to express your ideas in many ways for the whole group to understand. This is why experience is the best teacher—because when we experience something directly we usually are receiving information about it in more than one way.

Out in the natural environment of Keone'o'io, people can see, feel, hear and smell what is there. As you talk about Keone'o'io with them, they will be taking home much more than what you say; they will go home with a full experience of the place, enhanced by your interests and interpretative knowledge.

Here are some general guidelines to follow while participating in this program:

1) Be accurate.

Know the information you are sharing. Be accurate and precise with the meanings of words you use.

2) Encourage participation.

Be prepared to interact with residents and visitors from near and far. Encourage participation and inquiry from the general public. Learn from them as well. The best teacher is one who is always learning from his/her students. Utilize training and background materials, props, questioning strategies, games, etc. Understand that people learn best when all their senses are employed.

3) Practice effective group management.

Use your problem solving skills. Be ready to change direction, react professionally to unexpected situations, and find appropriate solutions when problems arise.

4) Be a team player.

Help other naturalists to better their performance through constructive feedback, and learn from theirs yourself. Work together as a team and share responsibilities of the program.

5) Be committed.

This program requires commitment. Determine the extent of your dedication to the materials, the organization, the land, and the project. Make commitments that you can keep. Carry out your responsibilities in a willing manner.

6) Be professional, and enjoy yourself!

This is meant to be a fun and rewarding experience for everybody involved. It requires a professionally composed but friendly presence. Most importantly, relax, enjoy yourself, and share the aloha spirit!

**Safety**

Your safety and the safety of others are of primary importance while at the site. Remember that Keone'o'io is very much a wild and remote place. Sharp lava can cause cuts, as can the reef. Be careful getting in and out of the water, as the surf is powerful in the bay. In general, be aware of your safety at all times, and carry a first aid kit when you go. Also, dehydration and overexposure to the sun are real dangers of the site—be sure to drink plenty of water and wear sunscreen or sun-protective clothing. Be prepared and stay aware!

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# Notes